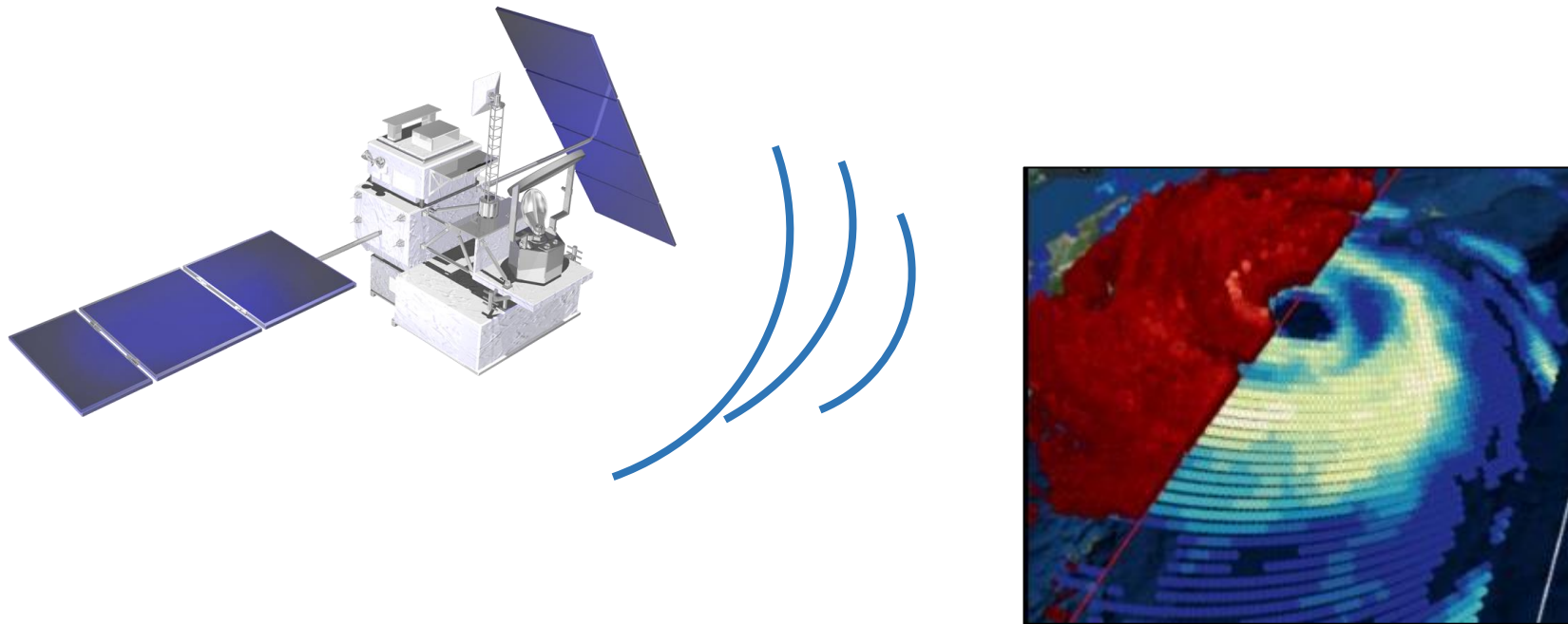




Web-Based Geospatial Visualization of GPM Data with CesiumJS



March 27, 2018

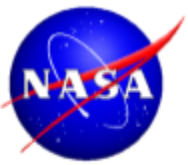
***Matt Lammers (matthew.r.lammers@nasa.gov)
Senior Science Data Visualization Analyst/Software Engineer
NASA Goddard Space Flight Center / SGT, Inc.***



Outline



- **GPM Data – What is it?**
- **CesiumJS – What is it? How can I use it?**
- **Putting the Two Together!**

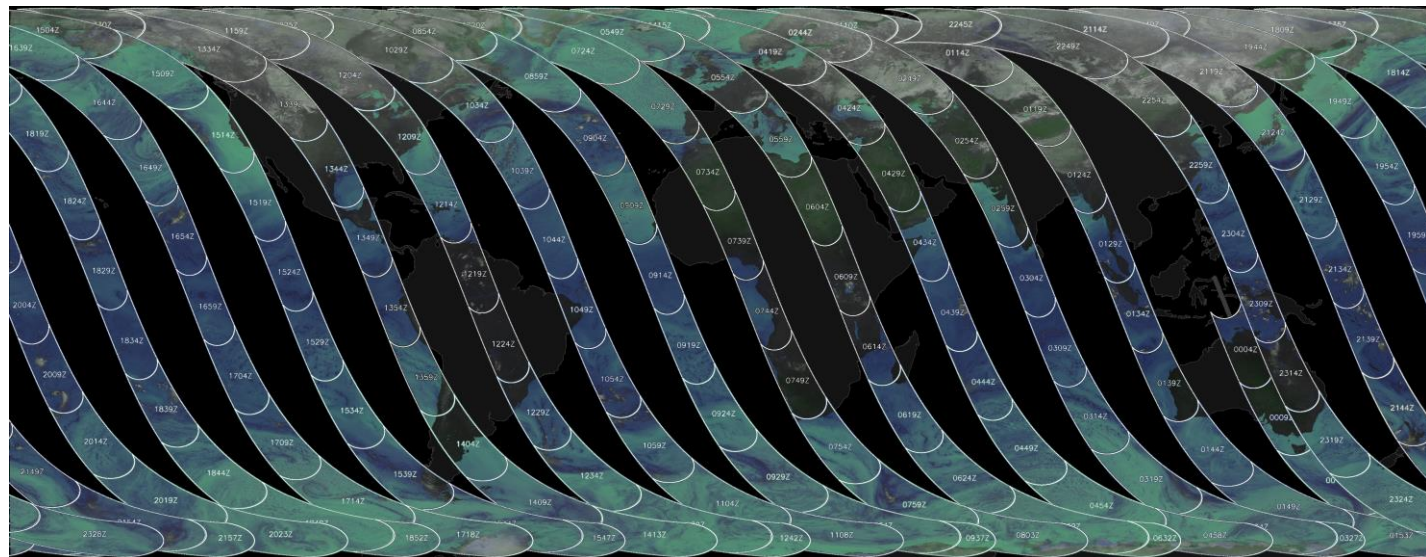


About GPM



- GPM: Global Precipitation Measurement Mission Core Satellite
- Contains Two Instruments: GPM Microwave Imager (GMI) and Dual-frequency Precipitation Radar (DPR)
- Orbits every ~ 90 minutes between $\pm 67^\circ$ Latitude

Latitude



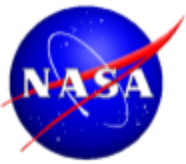


GPM Products



<https://storm.pps.eosdis.nasa.gov>

- Level 1: Raw Swath-Based Data
 - Counts from DPR
 - Brightness Temperature from GMI (and partner instruments)
- Level 2: Derived Swath-Based Data
 - Precipitation Variables from DPR and GMI (and partner instruments)
- Level 3: Aggregated Lat/Lon Gridded Data
 - Precipitation Variables from DPR and GMI (and partner instruments)

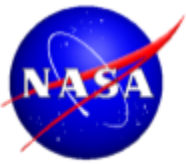


About CesiumJS



<https://cesiumjs.org>

- Open Source JavaScript Library for Visualizing Data On, Above, and Below the Earth's Surface
- Everything is Online
- Works with Time-Varying Data
- Moving Toward 3DTiles for Point Clouds, Vector Tiles, and 3D Shapes



CesiumJS Examples



<https://cesiumjs.org/demos>

The screenshot displays the CesiumJS demo interface. At the top, there are four buttons: "Full Screen", "Select Location", "Show Footprint", and "Select Polygon". The main view is a 3D globe showing the Earth with several satellite orbits overlaid in different colors (yellow, blue, green, purple). Labels for "SENTINEL-1A", "SENTINEL-2B", and "SENTINEL-3A" are visible on the globe. To the right of the globe is a "Satellites:" control panel with a list of satellite names and checkboxes. The checked satellites are SENTINEL-1A, SENTINEL-1B, SENTINEL-2A, SENTINEL-2B, SENTINEL-3A, and SENTINEL-5P. Below the list are buttons for "Show Orbits" and "Add Future Satellite". At the bottom left, there is a playback control interface with a play button, a pause button, and a stop button. The time displayed is "Mar 7 2018 12:48:09 UTC". At the bottom center, there is a timeline with the text "CESIUM | bing © 2018 Microsoft Corporation | Earthstar Geographics SIO" and "Mar 8 2018 00:00:00 UTC".

Full Screen Select Location Show Footprint Select Polygon

Satellites:

- RISAT-1
- SARAL
- SCD 1
- SCD 2
- SENTINEL-1A
- SENTINEL-1B
- SENTINEL-2A
- SENTINEL-2B
- SENTINEL-3A
- SENTINEL-5P
- SHIYAN 1 (SY-1)
- SIMALU 1
- Select All

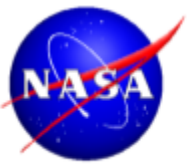
Show Orbits

Add Future Satellite

60x
Mar 7 2018
12:48:09 UTC

CESIUM | bing © 2018 Microsoft Corporation | Earthstar Geographics SIO

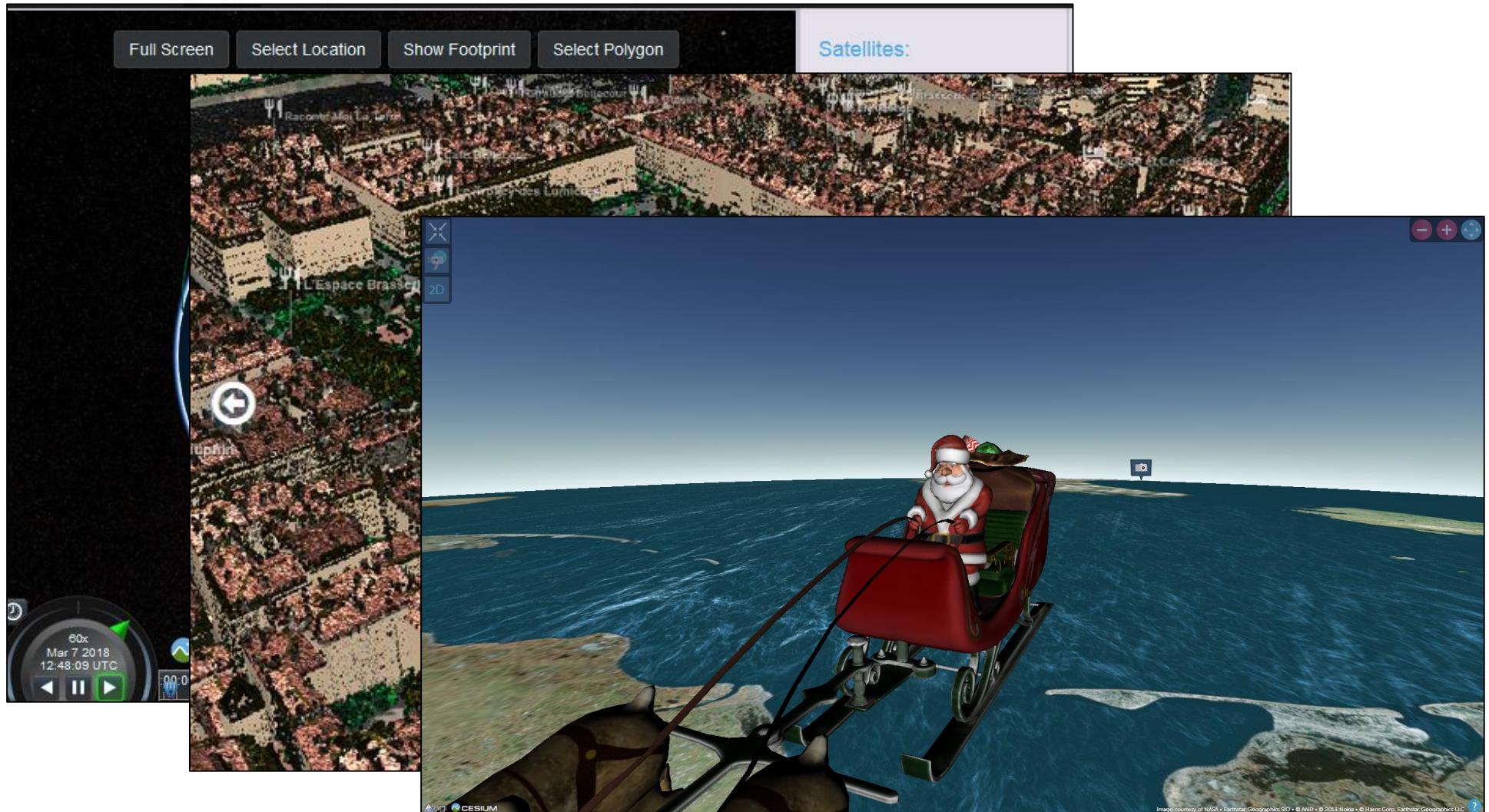
00:00 UTC Mar 8 2018 00:00:00 UTC Mar 8 2018 12

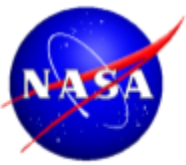


CesiumJS Examples



<https://cesiumjs.org/demos>

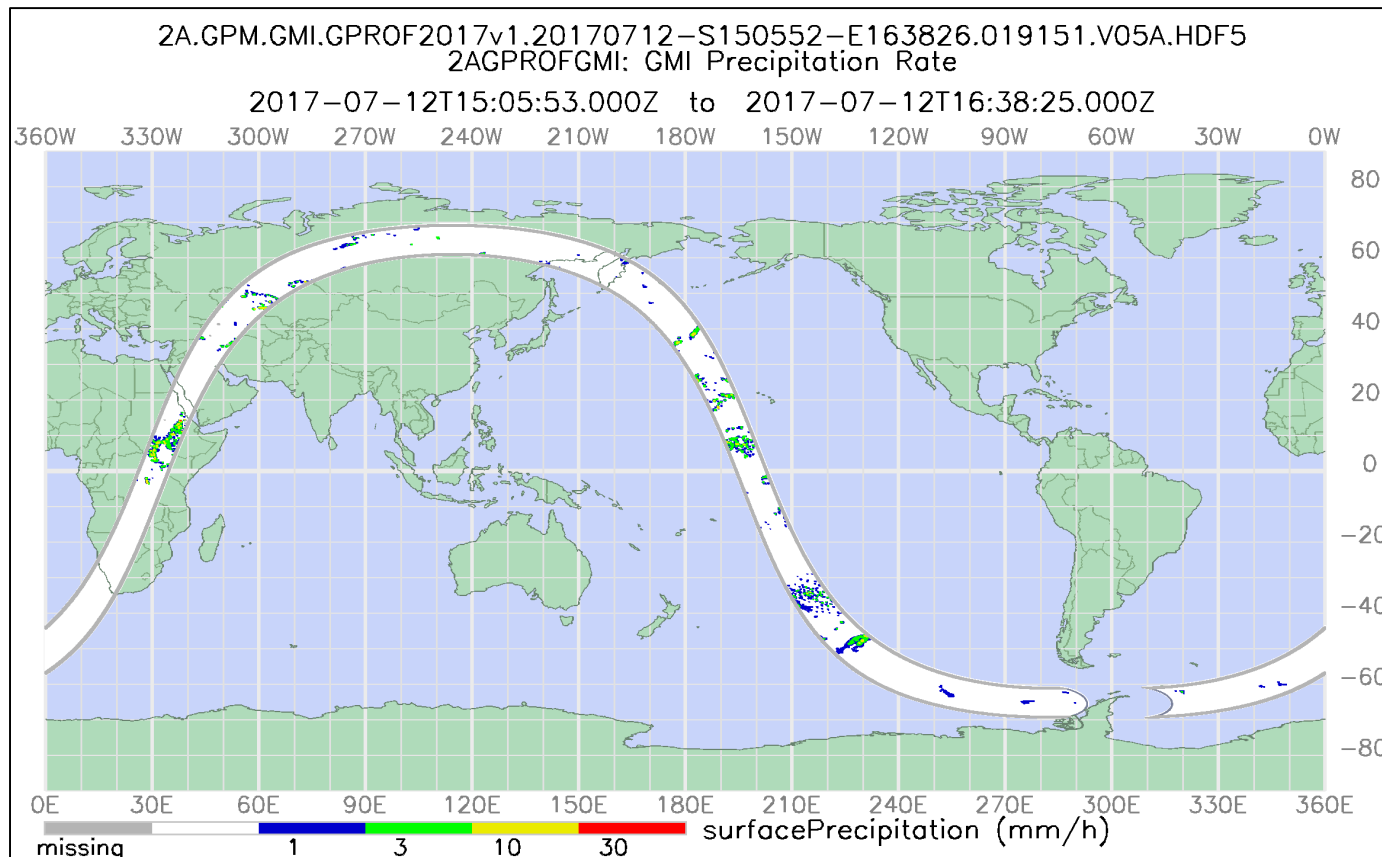


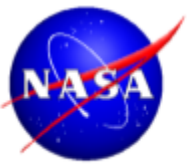


Putting Them Together



When I came to NASA, project scientists were making decisions about data acquisition based on static images.



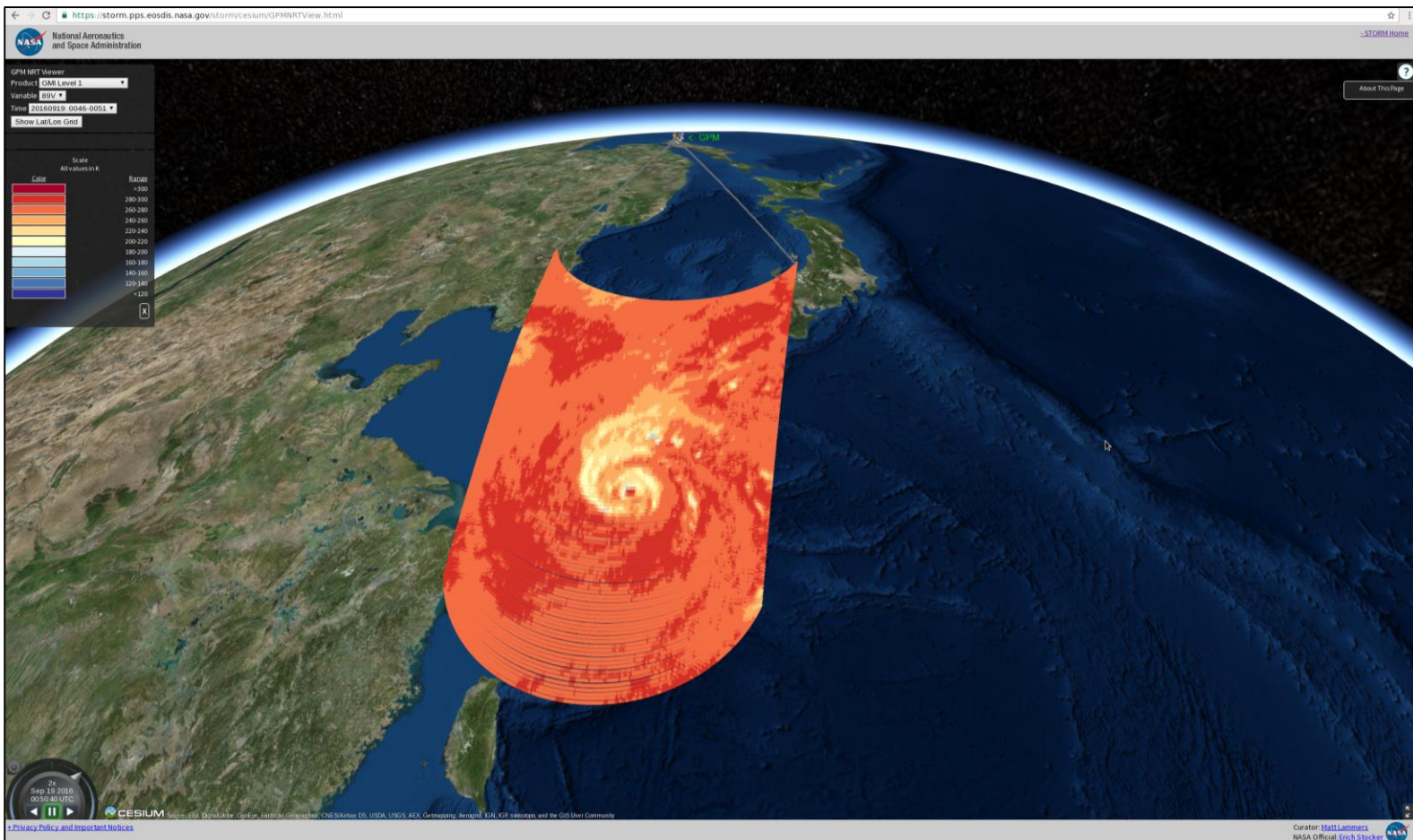


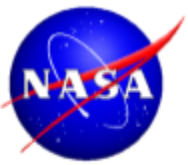
Putting Them Together



<https://storm.pps.eosdis.nasa.gov/storm/GPMNRTView.html>

Near Real Time Viewer



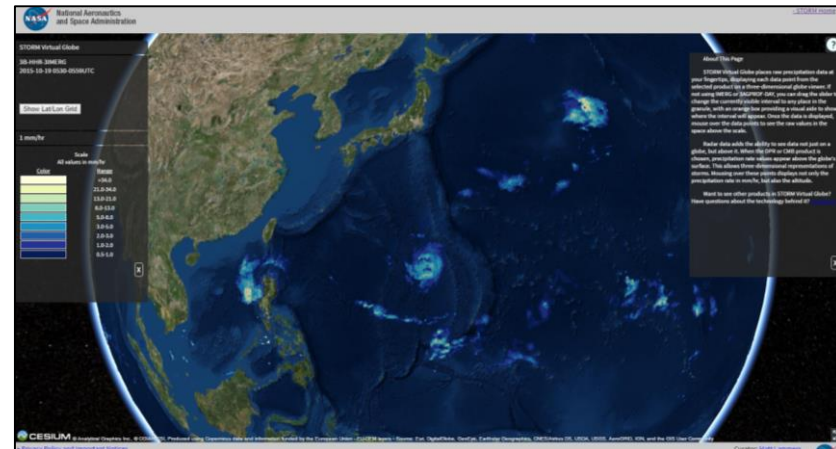
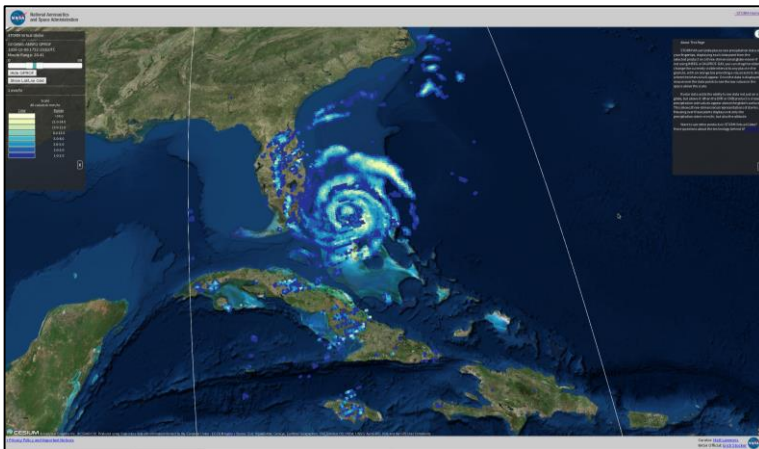
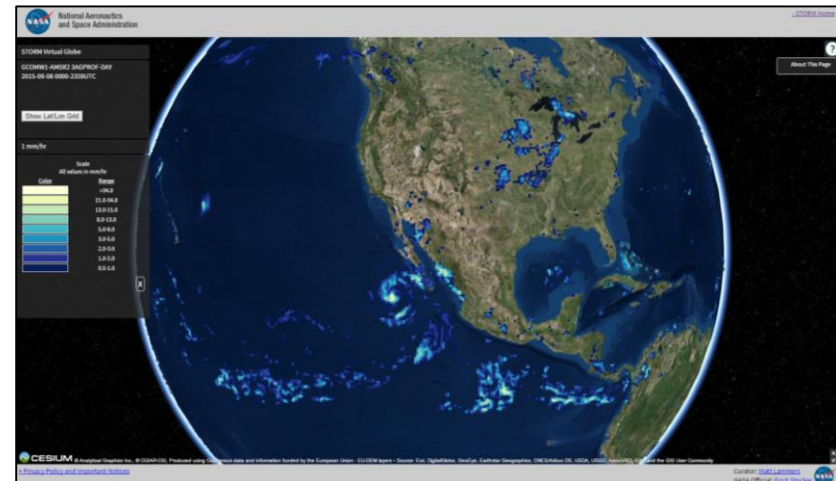
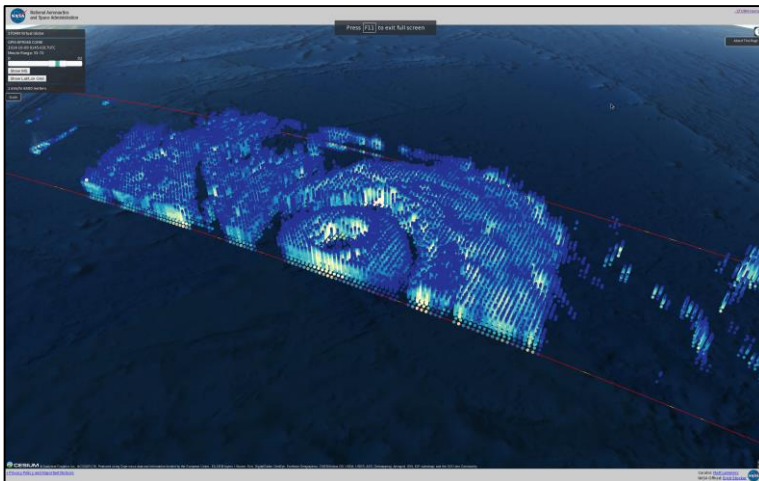


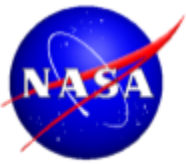
Putting Them Together



<https://storm.pps.eosdis.nasa.gov/storm/Tools.jsp>

Virtual Globe





Putting Them Together



<https://storm.pps.eosdis.nasa.gov/storm/Analysis.jsp>


Swath-Based Analysis Tool + Virtual Globe

Available Instruments:
Click to select one. Hold CTRL and click to select multiple.

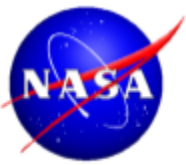
GPM-GMI	GPM-DPR	GPM-Ka MS	GPM-Ku
GPM-CMB	TRMM-TMI	NPP-ATMS	GCOMW1-AMSR2
NOAA15-AMSUB	NOAA16-AMSUB	NOAA17-AMSUB	NOAA18-MHS
NOAA19-MHS	METOPA-MHS	METOPB-MHS	F11-SSMI
F13-SSMI	F14-SSMI	F15-SSMI	F17-SSMIS
F18-SSMIS	F19-SSMIS	AQUA-AMSRE	

Date Range:
Valid Range is between 19971201 and 20180306
YYYYMMDD [HH.MM]
Start Date/Time 20140401
Stop Date/Time 20141231 23:59

Geographic Domain:
Use the buttons on the top-left to select a geographic area, or type the box into the inputs below.
Lat Lng:



Northern Latitude 26.096 Southern Latitude 33.937
Eastern Longitude 34.929 Western Longitude 31.721



Putting Them Together



<https://storm.pps.eosdis.nasa.gov/storm/Analysis.jsp>

Swath-Based Analysis Tool + Virtual Globe

Available Instruments:
Click to select one. Hold CTRL and click to select multiple.

<input checked="" type="checkbox"/> GPM-GMI	<input checked="" type="checkbox"/> GPM-DPR	<input type="checkbox"/> GPM-Ka MS	<input type="checkbox"/> GPM-Ku
<input type="checkbox"/> GPM-CMB	<input type="checkbox"/> TRMM-TMI	<input type="checkbox"/> NPP-ATM	
<input type="checkbox"/> NOAA15-AMSUB	<input type="checkbox"/> NOAA16-AMSUB	<input type="checkbox"/> NOAA17-AM	
<input type="checkbox"/> NOAA19-MHS	<input type="checkbox"/> METOP-A-MHS	<input type="checkbox"/> METOP-B-M	
<input type="checkbox"/> F13-SSMI	<input type="checkbox"/> F14-SSMI	<input type="checkbox"/> F15-SSM	
<input type="checkbox"/> F18-SSMIS	<input type="checkbox"/> F19-SSMIS	<input type="checkbox"/> AQUA-AMS	

Date Range:
Valid Range is between 19971201 and 20180306
YYYYMMDD [HH:MM]
Start Date/Time: 20140401
Stop Date/Time: 20141231 23:59


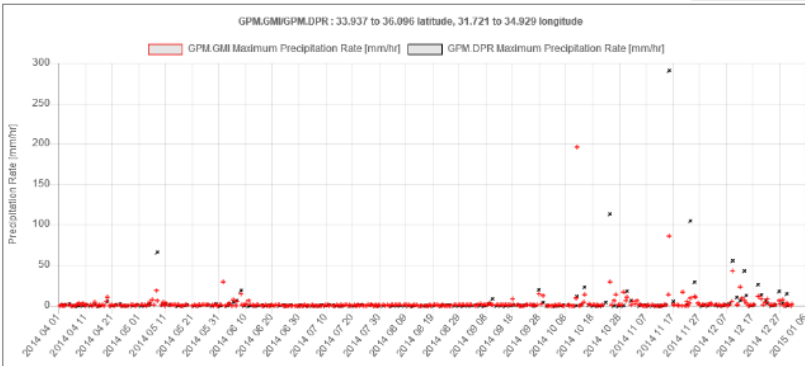
Geographic Domain:
Use the buttons on the top-left to select a geographic area.
Lat Lng:

Northern Latitude: 36.096 Southern Latitude: 33.937
Eastern Longitude: 34.929 Western Longitude: 31.721

Chart
Points Loaded: 566 of 566 Estimated Time Remaining: seconds [Pause Data Load](#)

GPM.GMI/GPM.DPR : 33.937 to 36.096 latitude, 31.721 to 34.929 longitude



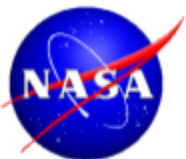
All Statistics are for Surface Precipitation Rate [Export All Data to CSV](#) [Export Chart Data to CSV](#) [Export Chart to PNG](#)
[Click Points for Prompt to View Granule in STORM Virtual Globe](#)

Chart Variables:
 Mean Conditional Mean Median Maximum Standard Deviation Percent of Pixels with Precipitation
Total Swath Pixels in Domain

Chart Instruments:
 GPM.GMI GPM.DPR

Chart Color and Point Style:
 Red - + Black - x Blue - * Green - o Purple - ^ Grey - □

Submit Order Based on Criteria:
Registered Email: Don't have a PPS Registered Email? [Register Here!](#)



Putting Them Together



<https://storm.pps.eosdis.nasa.gov/storm/Analysis.jsp>

Swath-Based Analysis Tool + Virtual Globe

Available Instruments:
Click to select one. Hold CTRL and click to select multiple.

GPM-GMI	GPM-DPR	GPM-Ka MS	GPM-Ku
GPM-CMB	TRMM-TMI	NPP-ATM	
NOAA15-AMSUB	NOAA16-AMSUB	NOAA17-AMSUB	
NOAA19-MHS	METOP-A-MHS	METOP-B-MHS	
F13-SSMI	F14-SSMI	F15-SSMI	
F18-SSMIS	F19-SSMIS		

Date Range:
Valid Range is between 19971201 and 20141231
YYYYMMDD [HH.MM]
Start Date/Time: 20140401
Stop Date/Time: 20141231 23:59

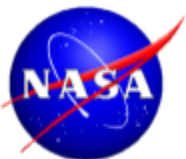
Geographic Domain:
Use the buttons on the top-left to select a geographic domain.
Lat Lng:
Northern Latitude: 36.096 Southern Latitude: 33.937
Eastern Longitude: 34.929 Western Longitude: 31.721

Chart
Points Loaded: 566 of 566
Estimated Time Remaining: seconds
Pause Data Load

GPM.GMI/GPM.DPR : 33.937 to 36.096 latitude, 31.721 to 34.929 longitude

Chart Color and Point Style:
Red - x Black - x Blue - * Green - o Purple - + Grey - □

Submit Order Based on Criteria:
Registered Email: Don't have a PPS Registered Email? [Register Here!](#)



Putting Them Together



<https://pmm.nasa.gov/storm-viewer/EventViewer.html>

Event Viewer

NASA National Aeronautics and Space Administration

STORM Event Viewer

Franklin
2017-08-09 1611-1641UTC

Events

Show Lat/Lon Grid

DPR Show Storm Top Height

1 mm/hr 3375 meters

Color	Range	Color
	>34.0	
	21.0-34.0	
	13.0-21.0	
	8.0-13.0	
	5.0-8.0	
	3.0-5.0	
	2.0-3.0	
	1.0-2.0	
	0.5-1.0	

Franklin 20170809B

Approaching hurricane force, Franklin has sustained winds around 60 knots near the center, as observed by the Hurricane Hunters. The storm appears lopsided, with dry air impinging on the northwestern side, while the southeastern side features intense rainfall, observed by GMI. DPR shows a tall cell (above 16km) in the eye wall, with deep convection in outer bands as well. The storm is expected to continue intensifying into a Category 1 storm before it makes landfall on the Mexican coast less than 24 hours from now.

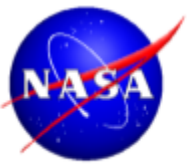
Want to see other events in STORM Event Viewer? Have questions about the technology behind it? [Contact Us](#) [Feedback](#)

The Dual-frequency Precipitation Radar and GPM Microwave Imager data are products of a joint mission between NASA and JAXA. If you are interested in the data, it is accessible through the [data](#) ordering interface.

CESIUM NASA/JAXA - Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

+ [Privacy Policy and Important Notices](#)

Curator: [Matt Lammers](#)
NASA Official: [Erich Stocker](#)

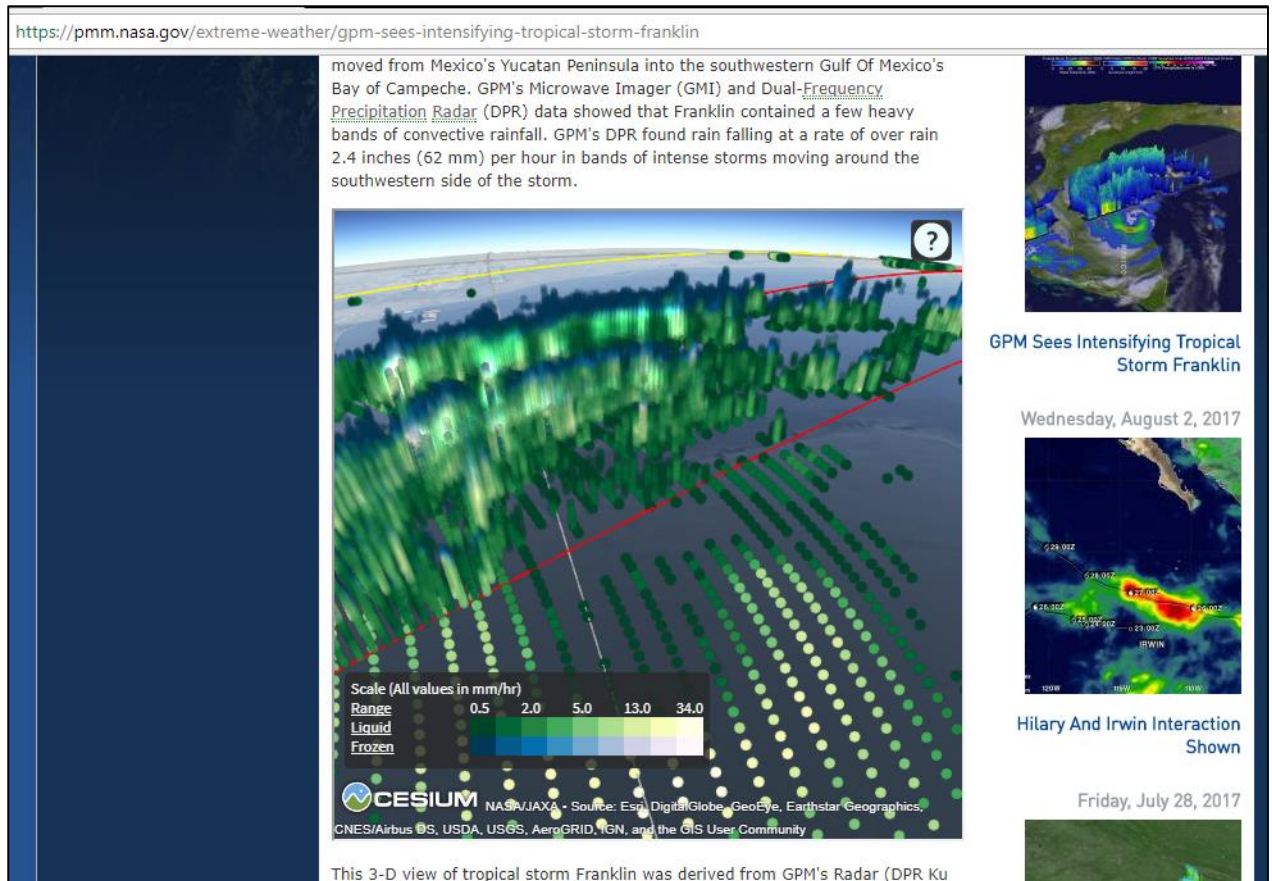
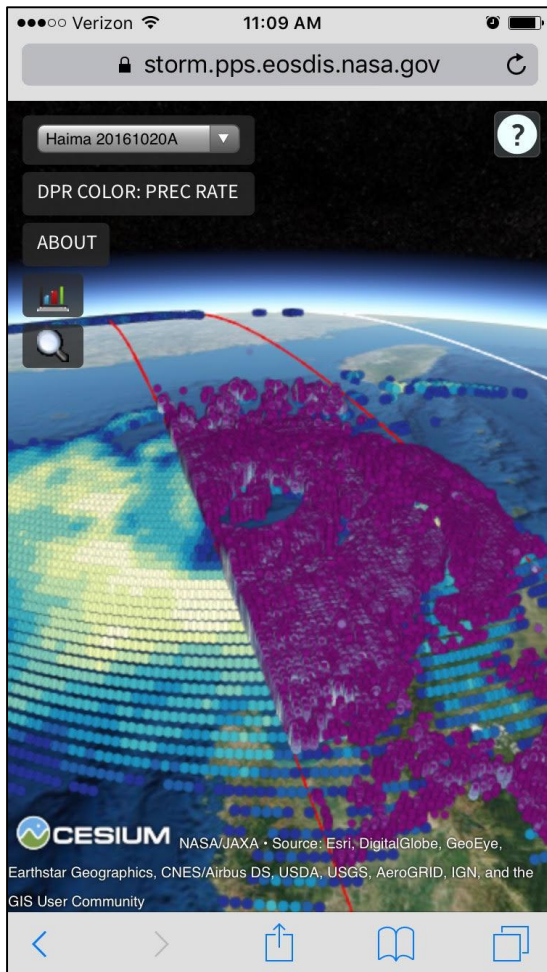


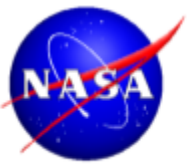
Putting Them Together



<https://pmm.nasa.gov/storm-viewer/EVMini.html>

EV Mini/EV Micro



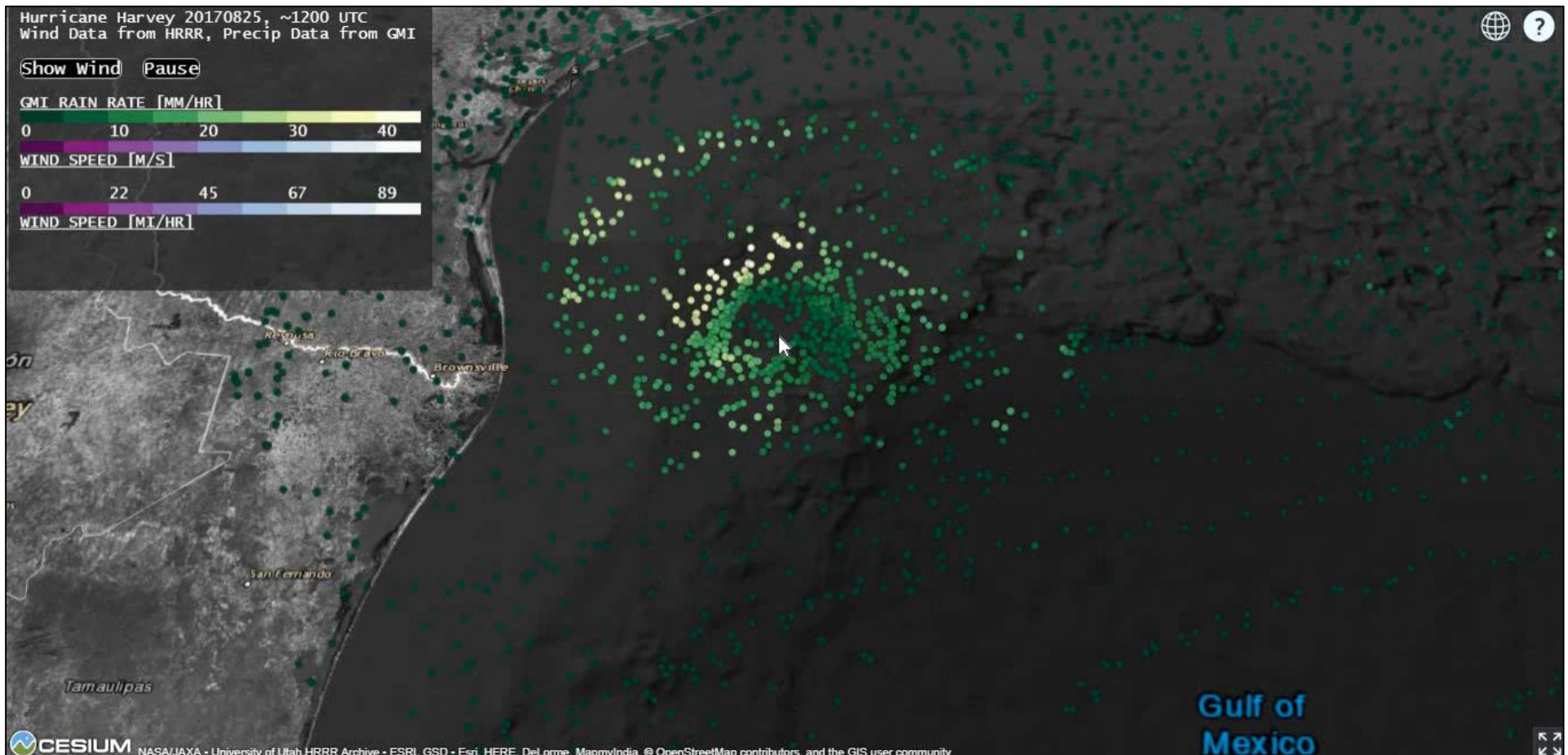


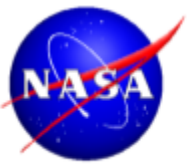
Putting Them Together



<https://storm.pps.eosdis.nasa.gov/storm/cesium/Spiral.html>

GMI/HRRR Spiral

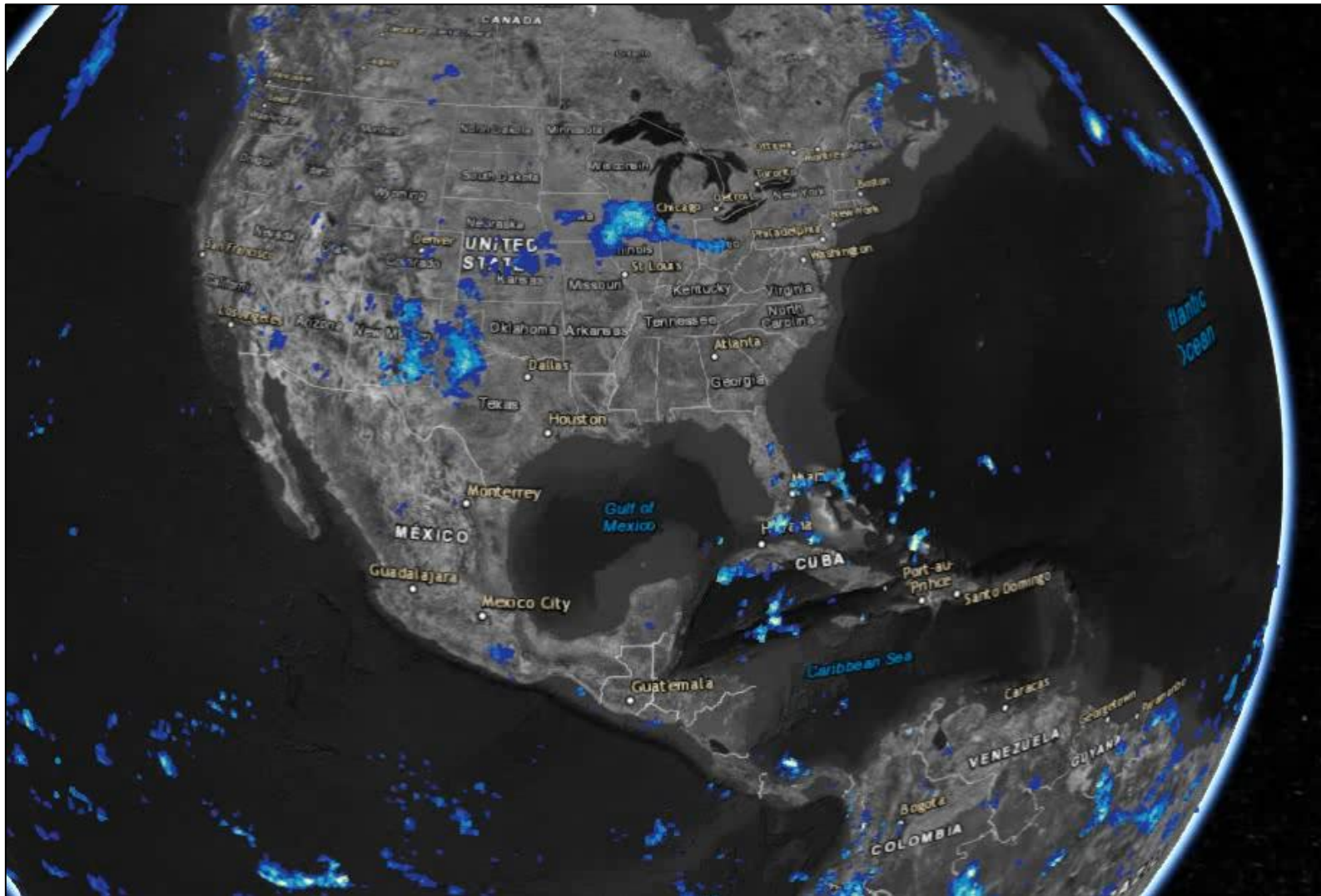


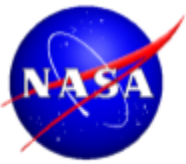


Putting Them Together



IMERG Time Lapse (Point Clouds)





Conclusion



- We have tons of precipitation-related satellite products from the last two decades
- Even if you don't use precipitation information, think about how your data can be made more interactive and displayed more fully using new technologies like CesiumJS
- Happy to discuss technical details rest of week

Questions?

matthew.r.lammers@nasa.gov

<https://storm.pps.eosdis.nasa.gov>

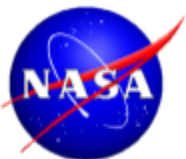
<https://cesiumjs.org>



Conclusion



Extra Slides...



Acquiring GPM Files



<https://storm.pps.eosdis.nasa.gov>

Need Help?

- Click on for context specific help.
- STORM User Guide
- Help Desk

Search Results

Left click on the header to sort columns. Right click to view additional info (file name, satellite, instrument, format and version).

Select	Data Type	Algorithm	Download / View	Start Time	Stop Time	Orbit #	Format
<input type="checkbox"/>							
<input type="checkbox"/>	2A	2AGPROFGMI		2016-03-08 23:58:18	2016-03-09 01:30:48	11519	hdf5
<input type="checkbox"/>	2A	2AGPROFGMI		2016-03-09 01:30:49	2016-03-09 03:03:19	11520	hdf5
<input type="checkbox"/>	2A	2AGPROFGMI		2016-03-09 03:03:20	2016-03-09 04:35:49	11521	hdf5
<input checked="" type="checkbox"/>	2A	2AGPROFGMI		2016-03-09 04:35:50	2016-03-09 06:08:19	11522	hdf5
<input type="checkbox"/>	2A	2AGPROFGMI		2016-03-09 06:08:20	2016-03-09 07:40:50	11523	hdf5
<input type="checkbox"/>	2A	2AGPROFGMI		2016-03-09 07:40:51	2016-03-09 09:13:21	11524	hdf5
<input type="checkbox"/>	2A	2AGPROFGMI		2016-03-09 09:13:22	2016-03-09 10:45:52	11525	hdf5
<input type="checkbox"/>	2A	2AGPROFGMI		2016-03-09 10:45:53	2016-03-09 12:18:22	11526	hdf5
<input checked="" type="checkbox"/>	2A	2AGPROFGMI		2016-03-09 12:18:23	2016-03-09 13:50:53	11527	hdf5
<input type="checkbox"/>	2A	2AGPROFGMI		2016-03-09 13:50:54	2016-03-09 15:23:26	11528	hdf5
<input type="checkbox"/>	2A	2AGPROFGMI		2016-03-09 15:23:27	2016-03-09 16:56:00	11529	hdf5
<input type="checkbox"/>	2A	2AGPROFGMI		2016-03-09 16:56:01	2016-03-09 18:28:34	11530	hdf5
<input checked="" type="checkbox"/>	2A	2AGPROFGMI		2016-03-09 18:28:35	2016-03-09 20:01:08	11531	hdf5
<input type="checkbox"/>	2A	2AGPROFGMI		2016-03-09 20:01:09	2016-03-09 21:33:42	11532	hdf5
<input type="checkbox"/>	2A	2AGPROFGMI		2016-03-09 21:33:43	2016-03-09 23:06:16	11533	hdf5
<input type="checkbox"/>	2A	2AGPROFGMI		2016-03-09 23:06:17	2016-03-10 00:38:50	11534	hdf5

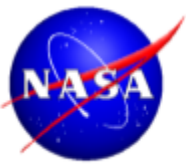
Total Granules selected: 3

1 Records from 1 to 16 of 16

Lammers – Page 5

RSCy 2018

March 26-29, 2018



Acquiring GPM Files



<https://storm.pps.eosdis.nasa.gov>

STORM Swath-Based Analysis Tool

This tool enables comparisons between domain-aggregated values from different instruments. Select one or more instruments, a date range, and a geographic domain. The tool provides an interactive graph, with the ability to change what statistics, what instruments, and what values are aggregated from swath pixels within the geographic domain selected.

Available Instruments:

Click to select one. Hold CTRL and click to select multiple.

GPM-GMI	GPM-DPR	GPM-Ka MS	GPM-Ku
GPM-CMB	TRMM-TMI	NPP-ATMS	GCOMW1-AMSR2
NOAA15-AMSUB	NOAA16-AMSUB	NOAA17-AMSUB	NOAA18-MHS
NOAA19-MHS	METOPA-MHS	METOPB-MHS	F11-SSMI
F13-SSMI	F14-SSMI	F15-SSMI	F17-SSMIS
F18-SSMIS	F19-SSMIS	AQUA-AMSRE	

Date Range:

Valid Range is between 19971201 and 20180305

YYYYMMDD [HH:MM]

Start Date/Time 20170301

Stop Date/Time 20170302 23:59

Geographic Domain:

Use the buttons on the top-left to select a geographic area, or type the box into the inputs below.

Lat Lng:



STORM Near-Real Time Download Page

Input your NRT Registered Email:

Register Your Email [HERE](#). Make sure you Check that you are interested in NRT products.

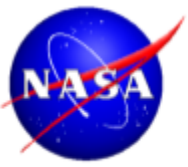
Use the interface below as if it is a directory tree. Click on a filename to initiate the download process (which will occur in a new tab).

You can also acquire files programmatically using the API that drives this site. An example request would be: [https://storm.pps.eosdis.nasa.gov/storm/NRT?email=\[youremail\]&filename=data/documentation/IMERG_doc.pdf](https://storm.pps.eosdis.nasa.gov/storm/NRT?email=[youremail]&filename=data/documentation/IMERG_doc.pdf). Replace the [youremail] with your registered email and use the directory tree here to ensure the filename path is correct.

- ▶ data/1C
- ▶ data/1CR
- ▶ data/combine
- ▶ data/documentation
- ▶ data/GMI1B
- ▶ data/GPROF
- ▶ data/imerg
 - ▶ imerg
 - ▶ early
 - ▶ gis
 - ▶ 01
 - ▶ 02
 - ▶ 2014
 - ▶ 2015
 - ▶ 2016
 - ▶ 2017
 - ▶ early
 - ▶ 2014
 - ▶ 2015
 - ▶ 2016
 - ▶ 2017
 - ▶ 2018
 - ▶ 01
 - ▶ 02
 - ▶ 03

3B-HHR-E.MS.MRG.3IMERG.20180301-S000000-E002959.0000.V05B.30min.tfw

3B-HHR-E.MS.MRG.3IMERG.20180301-S000000-E002959.0000.V05B.30min.tif



Point Clouds

